

## CONTRIBUTIONS TO A KNOWLEDGE OF AUSTRALIAN FORAMINIFERA. PART I.

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(Plate xxiii.)

The present paper is in the main a compilation of species which I have identified in sands and other materials obtained from various quarters. It is the result of over four years' intermittent work on, and study of, our foraminiferal fauna. Very few new species have been discovered, thanks to the very thorough work of previous workers, especially Brady, who described and figured those dredged on the voyage of the 'Challenger.' Many varieties differing in minor details from those already known and figured were found in the present research, but as the custom of creating new species on trivial differences is objectionable, I have assigned them to the species to which they exhibited most affinity, making a special note where the difference was somewhat marked. The work has been done in the Biological and Geological Departments of the Sydney University, to which I wish to express my gratitude for courtesy shown.

Sands from Wollongong, Byron Bay, Sydney Heads, Lizard Island, the Palm Islands, New Guinea, and Lord Howe Island, as well as dust from a specimen of *Turritella* limestone and sections of Pokolbin limestone have been examined for Foraminifera.

1. *Foraminiferal sand dredged sixteen miles east of Wollongong at a depth of 100 fathoms by Messrs. Chas. Hedley and G. H. Halligan.*

For this material I am indebted to the above-mentioned gentlemen, and the mollusca in the same material have been fully

investigated by Mr. C. Hedley.\* The material which is here investigated is a somewhat fine-grained sand, many of the particles of which, both organic and inorganic, were of a reddish colour owing to iron oxide staining. The ferruginous matter has probably been derived from the decomposition of basalt, similar to the adjoining Kiama basalt, which probably forms the sea-floor in this area.

No distinctly new species were distinguished in this material.

The species identified in each subfamily are here divided into two series, (a) those which also occur in Port Jackson and which are enumerated in Whitelegge's List,† and (b) those which have not been mentioned by Whitelegge as occurring in Port Jackson.

References to figures are given in the same way as in Whitelegge's List; but no references are given for species mentioned therein. Mr. Whitelegge's abbreviation C.R. for "Challenger Report" is used in this paper.

### Family NUBECULARIDÆ.

#### Subfamily MILIOLININÆ.

- (a) 1. SPIROLOCULINA IMPRESSA.
- 2. S. LIMBATA.
- (b) 3. PLANISPIRINA EXIGUA, Brady, C.R., pl.xii. f.1-4.
- 4. P. SIGMOIDEA, Brady, C.R., pl.ii. f.1.
- 5. SPIROLOCULINA ARENARIA, Brady, C.R., pl.viii. f.12.
- 6. S. FRAGILISSIMA, Brady, C.R., pl.ix. f.12.
- 7. S. EXCAVATA, d'Orb.; C.R., pl.ix. f.5-6.
- 8. MILIOLINA ALVEOLIFORMIS, Brady, C.R., pl.viii. f.15-20.

#### Subfamily PENEROPLIDINÆ.

- (b) 9. CORNUSPIRA INVOLVENS, Reuss; C.R., pl.xi. f.3.

\* Studies on Australian Mollusca. Part viii. Proc. Linn. Soc. N. S. Wales, 1904, xxix. 82.

† "List of the Marine and Fresh-water Invertebrate Fauna of Port Jackson and Neighbourhood." Journ. Proc. Roy. Soc. N. S. Wales, xxviii. 1889.

Family **ASTRORRHIZIDÆ**.Subfamily **ASTRORRHIZINÆ**.

- (b) 10. *PELOSINA ROTUNDATA*, Brady, C.R., pl.xxv. f.18-20.

Family **LITUOLIDÆ**.Subfamily **LITUOLINÆ**.

- (b) 11. *HAPLOPHRAGMIUM FOLIACEUM*, Brady, C.R., pl.xxxiii.f.23.

Subfamily **TROCHAMMININÆ**.

- (a) 12. *WEBBINA CLAVATA*.

- (b) 13. *TROCHAMMINA PAUCILO-CULATA*, Brady, C.R., pl.xli. f.1-2.

Family **TEXTULARIDÆ**.Subfamily **TEXTULARINÆ**.

- (a) 14. *TEXTULARIA AGGLUTINANS*.

- (b) 15. *SPIROPECTA BIFORMIS*, Parker & Jones; C.R., pl.xlv. f.26-27.

16. *S. AMERICANA*, Ehrenberg; C.R., pl.xlv. f.24-25.

17. *PAVONIA FLABELLIFORMIS*, d'Orb.; C.R., pl.xlv. f.18.

18. *GAUDRYINA FILIFORMIS*, Berthelin; C.R., pl.xlvi. f.12,*a,b,c*.

19. *G. SUBROTUNDATA*, Schwager; C.R., pl.xlvi. f.13,*a,b,c*.

Subfamily **BULIMININÆ**.

- (a) 20. *BULIMINA BUCHIANA*.

21. *B. PYRULA*.

- (b) 22. *BULIMINA MARGINATA*, d'Orb.; C.R., pl.li. f.3.

23. *BOLIVINA DILATATA*, Reuss; C.R., pl.lii. f.20-21.

24. *B. HANTKENIANA*, Brady, C.R., pl.liii. f.16-18.

25. *B. NITIDA*, Brady, C.R., pl.lii. f.30.

26. *B. PYGMÆA*, Brady, C.R., pl.liii. f.5, 6.

Subfamily **CASSIDULININÆ**.

- (b) 27. *EHRENBERGIA PUPA*, d'Orb.; C.R., pl.lv. f.1.

Family **CHILOSTOMELLIDÆ**.

- (a) 28. *CHILOSTOMELLA OVOIDEA*.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

- (a) 29. LAGENA SULCATA.
- 30. L. STRIATOPUNCTATA.
- (b) 31. L. GLOBOSA, Montagu; C.R., pl.lvi. f.1-3.
- 32. L. HISPIDA, Reuss; C.R., pl.lvii. f.4.
- 33. L. LÆVIS, Montagu; C.R., pl.lvi. f.30, and pl.i. f.2.
- 34. L. STRIATA, d'Orb.; C.R., pl.lvii. f.28.
- 35. L. SULCATA\* var. HISPIDA; bottom species.
- 36. L. SULCATA,\* Walker & Jacob; apiculate varieties; C.R., pl.lviii. f.4, 17, 18.
- 37. RAMULINA sp.

Subfamily NODOSARINÆ.

- (a) 38. NODOSARIA SCALARIS,† pl.xxvi. f.1.
- 39. N. HISPIDA.
- (b) 40. NODOSARIA (DENTALINA) FILIFORMIS, d'Orb.; C.R., pl.lxiii. f.4.
- 41. N. PYRULA, d'Orb.; C.R., pl.lxii. f.10-11.
- 42. N. VERTEBRALIS, Batsch; C.R., pl.xliii. f.35; diminutive or young two-chambered specimen.
- 43. LINGULINA CARINATA, d'Orb.; C.R., pl.lxv. f.16; diminutive specimen.
- 44. CRISTELLARIA CREPIDULA, Fichtel & Moll.; C.R., pl.lxviii. f.1, and pl.lxvii. f.17.

Subfamily POLYMORPHININÆ.

- 45. POLYMORPHINA SORORIA, Reuss; var. pl.xxvi. f.3, and C.R., pl.lxxi. f.15; see p.817.
- 46. SAGRINA ANSULATA, Brady, C.R., pl.lxxvi. f.20.

Family GLOBIGERINIDÆ.

- (a) 47. GLOBIGERINA BULLOIDES.
- 48. G. SACCULIFERA.

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\* See Notes on Wollongong Foraminifera. *Postea*, p.815.

† See Notes on Wollongong Foraminifera.

- 49. ORBULINA UNIVERSA.
- 50. PULLENIA OBLIQUILOCLATA.
- 51. SPHEROIDINA DEHISCENS.
- (b) 52. GLOBIGERINA CRETACEA, d'Orb.; C.R., pl.lxxxii. f.10.
- 53. G. ÆQUILATERALIS, Brady, C.R., pl.lxxx. f.18-20.
- 54. CANDEINA NITIDA, d'Orb.; C.R., pl.lxxxii. f.13-20.
- 55. GLOBIGERINA LINNÆANA, d'Orb.; C.R., pl.lxxxii. f.12.
- 56. HASTIGERINA PELAGICA, d'Orb.; C.R., pl.lxxxiii.

### Family ROTALIDÆ.

#### Subfamily SPIRILLININÆ.

- (b) 57. SPIRILLINA VIVIPARA, Ehrenberg; C.R., pl.lxxxv. f.1-5.

#### Subfamily ROTALINÆ.

- (a) 58. DISCORBINA ALLOMORPHINOIDES.
- 59. D. BICONCAVA.
- 60. D. OPERCULARIS.
- 61. TRUNCATULINA HAIDINGERII.
- 62. T. WUELLERSTORFII.
- 63. PULVINULINA CRASSA.
- 64. P. MENARDI.
- (b) 65. DISCORBINA BERTHELOTI, d'Orb.; C.R., pl.lxxxix. f.10-11.
- 66. D. GLOBULARIS, d'Orb.; C.R., pl.lxxxvi. f.13.
- 67. D. PATELLIFORMIS, Brady, C.R., pl.lxxxviii. f.3, a, b, c.
- 68. D. PARISIENSIS, d'Orb.; C.R., pl.xc. f.5, 6, 9-12.
- 69. D. VILARDEBOANA, d'Orb.; C.R., pl.lxxxvi. f.9.
- 70. D. RUGOSA, d'Orb.; C.R., pl.lxxxvii. f.3.
- 71. ANOMALINA AMMONOIDES, Reuss; C.R., pl.xciv. f.2 and 3.
- 72. PLANORBULINA (TRUNCATULINA) AKNERIANA, d'Orb.; C.R., pl.xciv. f.8, a, b, c.
- 73. TRUNCATULINA HUMILIS, Brady, C.R., pl.xciv. f.7.
- 74. T. PYGMÆA, Hantken; C.R., pl.xcv. f.9-10.
- 75. T. ROBERTSONIANA, Brady, C.R., pl.xcv. f.46.
- 76. T. TUMIDULA, Brady, C.R., pl.xcv. f.8.
- 77. T. UNGUERIANA, d'Orb.; C.R., pl.xciv. f.9.
- 78. PULVINULINA ELEGANS, d'Orb.; C.R., pl.cv. f.3-6.

79. *P. OBLONGA*, var. *SCABRA*, Williamson; Brady, C.R., pl.cvi. f.8c.  
 80. *P. PATAGONICA*, d'Orb.; C.R., pl.ciii. f.7.  
 81. *TRUNCATULINA VARIABILIS*, d'Orb.; C.R., pl.xciii. f.6 and 7.  
 82. *ANOMALINA ARIMIENSIS*, d'Orb.; C.R., pl.xciii. f.10, b.  
 83. *ROTALIA VENUSTA*, Brady, C.R., pl.cviii. f.2.

Subfamily **TINOPORINÆ**.

- (b) 84. *CARPENTARIA UTRICULARIS*, Carter; C.R., pl.c. f.1.  
 85. *POLYTREMA* sp. (fragments).

Family **NUMMULINIDÆ**.Subfamily **POLYSTOMELLINÆ**.

- (a) 86. *NONIONINA UMBILICATA*.  
 (b) 87. *NONIONINA SCAPHA*, Fichtel & Moll.; C.R., pl.cix. f.16.  
 88. *POLYSTOMELLA CRISPA*, Linné; C.R., pl.cx. f.6-7.  
 89. *P. SUBNODOSA*, Münster; C.R., pl. cx. f.1.  
 90. *P. MACELLA*, Fichtel & Moll.; C.R., pl.cx. f.8, 9, 11; and pl.xxvi. f.4. See also p.817.

*Notes on the Wollongong Foraminifera.*

It is an interesting fact that most of the *Milioline* in the Wollongong material were micromorphs. The natural habitat of this family seems to be the shallow water near the shore; possibly micromorphism has resulted from unfavourable conditions.

*Lageninæ* were very numerous, and the species merge into one another. *Lagena striata* was found sometimes with one, or several apical spines, sometimes without any at all, merging into corresponding forms of *L. sulcata*. Forms like *L. hispida* frequently have their necks ringed after the manner of *L. sulcata*, and *L. sulcata* frequently has a neck like that of *L. hispida*; some specimens of *L. sulcata* were provided with one or more apical spines, and had their necks ringed with parallel ring-like ridges (cp. C.R., pl.lviii. f.4) instead of the usual spiral ridge. There does not seem to me to be any marked division line between these species of *Lagena*, but they merge into one another

by imperceptible gradations. Indeed there seems to be no reason why they should not be considered merely as large varieties of *L. sulcata*, which, according to Messrs. Parker and Jones, is the type-species of the genus. The species *acuticostata*, *exsculpta*, and *striata* also merge into *L. sulcata*.

The genus *Lagena* being such a large genus, it is desirable to maintain for convenience the present species, although many may possibly be merely varieties, variation in the lower orders of life being exceedingly frequent and well-marked. The creation of new species, on any but very extraordinary points of difference, seems to me to be undesirable, particularly in the genus *Lagena*, which is already almost overcrowded with species, and in which species could be almost indefinitely multiplied if minor variations from type are made to constitute specific differences.

Many of the *Lagena*-like forms are possibly young specimens of *Nodosaria*. In its early stages *Nodosaria scalaris* is a *Lagena sulcata*, provided with an apical spine and a neck like *L. hispida*. The specimens of *L. sulcata* answering to the above description are indistinguishable from *N. scalaris* except for containing only one chamber instead of two.

*Nodosaria scalaris* (Pl.xxiii., fig.1) is very abundant, but differs very remarkably from the type, as figured in the Challenger Report. The ribs are fewer and more strongly marked. The chambers are seldom more than two in number, and the size of the organism is diminutive. Many specimens have dentate processes or spines at the initial (apical) end like the apiculate varieties of *L. sulcata* and *L. striata*; sometimes these are very strongly marked as in *N. abyssorum*, Brady (C.R., pl.lxiii. f.9), or *L. striata*, d'Orb. (C.R., pl.lvii. f.29-30).

Perhaps on account of the remarkable micromorphism and variability of this organism, and its relation to some forms of *L. sulcata*, it would have been permissible to make a new species of it.

Specimens of *Lagena laevis* (pl.xxvi. f.2) differ slightly from the type. Some are provided with apical spines.

*Polymorphina sororia* (Pl.xxiii., f.3) is rare in the Wollongong material, and is somewhat different from the type figured in the Challenger Report. The test is frail and of similar composition to that of *Lagena*, and the aperture is polymorphine. There are only two chambers, one of which is enclosed in the other as in *Chilostomella ovoidea*. The forms found in the Wollongong material were either young or micromorphic. The diameter was 0.25 mm.

The *Polystomella* specimen figured (Pl.xxiii., f.4) and enlisted as *P. macella* differs from the type of the species by possessing a marked umbilicus on either side in which the inner whorls are clearly visible. It is thus biconcave. Perhaps it also deserves to be ranked as a new species.

Micromorphism was most marked in the following species of *Miliolinae*:—*Spiroloculina seminulum*, *S. fragilissima*, *S. excavata*, *S. limbata* (diam. up to 0.3 mm.), *S. impressa*, and also in many of the *Lagenidae*, *Rotalidae* and others, such as *Nodosaria scalaris*, *N. vertebralis*, *Truncatulina ungueriana*, *Anomalina arimiensis* (diam. 0.25 mm.), *Gaudryina subrotundata*, &c.

The depth at which the dredgings were made (100 fathoms) and the distance from land (16 miles) were evidently not the optimum for these forms. *Globigerina* was by far the most abundant organism in the material, which might almost be termed a *Globigerina* ooze. Only twenty-four of the ninety species enumerated here occur also in Mr. Whitelegge's List of the Port Jackson forms.

## 2. *Foraminiferal Sand dredged at Byron Bay at a depth of 111 fathoms.*

For this material I am indebted to Mr. G. H. Halligan, through Mr. C. Hedley. As yet only the coarser shell-sands from this locality have been examined. In this list and in the list of forms identified in sands from other localities forming the rest of this paper, the species mentioned by Whitelegge as occurring in Port Jackson are denoted by an asterisk.



## Family MILIOLIDÆ.

## Subfamily MILIOLINÆ.

1. BILOCULINA BULLOIDES, d'Orb.; C.R., pl.ii. f.5-6.
2. B. ELONGATA, d'Orb.; C.R., pl.ii. f.9.
3. B. RINGENS,\* Lamk.
4. B. SPHÆRA, d'Orb.; C.R., pl.ii. f.4.
5. B. TUBULOSA, Costa; C.R., pl.iii. f.6.
6. MILIOLINA BOUEANA, d'Orb.; C.R., pl.vii. f.13.
7. M. (TRILOCULINA) BUCCULENTA, Brady, C.R., pl.iv. f.1-2.
8. M. CRASSATINA,\* Brady, C.R., pl.viii. f.5.
9. M. LABIOSA, d'Orb.; C.R., pl.vi. f.3-5.
10. M. LINNÆANA, d'Orb.; C.R., pl.vi. f.15-20.
11. M. SECANS, d'Orb.; C.R., pl.vi. f.1-2.
12. M. SEMINULUM,\* Linné; C.R., pl.v. f.6.
13. M. SEPARANS, Brady, C.R., pl.vii. f.1-4.
14. M. TRIGONULA, Lamk.; C.R., pl.iii. f.14-16.
15. M. VALVULARIS, Reuss; C.R., pl.iv. f.4-5.
16. SPIROLOCULINA ASPERULA, Karrer; C.R., pl.viii. f.11, 12, 13.
17. S. EXCAVATA, d'Orb.; pl.ix. f.5-6.
18. S. LIMBATA,\* d'Orb.
19. S. TENUISEPTATA, Brady, C.R., pl.x. f.5-6.

## Subfamily HAUERININÆ.

20. PLANISPIRINA SIGMOIDEA, Brady, C.R., pl.ii. f.5-6.

## Subfamily PENEROPLIDINÆ.

21. PENEROPLIS PERTUSUS,\* Forskäl; C.R., pl.xiii. f.12-15 and 20-25.

## Family ASTRORHIZIDÆ.

## Subfamily RHABDAMMININÆ.

22. JACULELLA ACUTA, Brady, C.R., pl.xxii. f.14-18.

## Family LITUOLIDÆ.

## Subfamily TROCHAMMININÆ.

23. THURAMMINA PAPILLATA, Brady, C.R., pl.xxxvi. f.7-18.
24. HIPPOCREPINA sp.

- 25. *AMMODISCUS TENUIS*, Brady, C.R., pl.xxxviii. f.4-6.
- 26. *HORMOSINA MONILE*, Brady, C.R., pl.xxxix. f.10-13.
- 27. *TROCHAMMINA SQUAMATA*, Jones & Parker; C.R., pl.xli. f.3.

Subfamily **LITUOLINÆ**.

- 28. *RHEOPHAX EUNETA*, n.sp., Pl.xxiii., figs.1-4; see p.821.

Family **TEXTULARIDÆ**.Subfamily **TEXTULARINÆ**.

- 29. *TEXTULARIA AGGLUTINANS*,\* d'Orb.
- 30. *T. LUCULENTA*,\* Brady.
- 31. *T. TURRIS*, d'Orb.; pl.xliv. f.4-5.
- 32. *GAUDRYINA SUBROTUNDATA*, Schwager; C.R., pl.xlvi. f.13.
- 33. *G. SCABRA*, Brady, C.R., pl.xlvi. f.7.

Subfamily **CASSIDULININÆ**.

- 34. *CASSIDULINA CRASSA*,\* d'Orb.
- 35. *C. PARKERIANA*, Brady, C.R., pl.liv. f.11-16.

Family **CHILOSTOMELLIDÆ**.

- 36. *CHILOSTOMELLA OVOIDEA*,\* Reuss.
- 37. *ALLOMORPHINA* sp.

Family **LAGENIDÆ**.Subfamily **LAGENINÆ**.

- 38. *LAGENA ACUTICOSTATA*,\* Reuss.

Subfamily **NODOSARINÆ**.

- 39. *NODOSARIA COMMUNIS*,\* d'Orb.
- 40. *N. CONSOBRINA*, var. *EMACIATA*, Reuss; C.R., pl.lxii. f.25-26.
- 41. *N. COSTULATA*, Reuss; C.R., pl.lxiii. f.23-26.
- 42. *N. OBLIQUA*,\* Linné.
- 43. *N. PERVERSA*, Schwager; C.R., pl.lxiv. f.25-27.
- 44. *N. ROEMERI*, Neugeboren; C.R., pl.lxiii. f.1.
- 45. *N. SOLUTA*,\* Reuss.
- 46. *N. VERTEBRALIS*, Batsch; C.R., pl.lxiv. f.11-13.
- 47. *N. (DENTALINA) FILIFORMIS*, d'Orb; C.R., pl.lxiii. f.3-5.

48. CRISTELLARIA CREPIDULA, Fichtel & Moll; C.R., pl.lxvii f.17, 19, 20.
49. C. NITIDA, d'Orb.; C.R., pl.lxx. f.2.
50. C. ORBICULARIS,\* d'Orb.
51. C. ROTULATA,\* Lamk.
52. C. CULTRATA, Montfort; C.R., pl.lxx. f.4-6.
53. C. ITALICA,\* DeFrance.
54. C. LATA, Cornuel; C.R., pl.lxvii. f.18.
55. C. VORTEX, Fichtel & Moll; C.R., pl.lxix. f.14-16.
56. LINGULINA sp.
57. LINGULINA CARINATA, var. SEMINUDA, Hantken; C.R., pl.lxv. f.14-15 (see also p.822, and Pl.xxiii., fig.1).
58. FRONDICULARIA INÆQUALIS, Costa; C.R., pl.lxvi. f.8-12.

Subfamily **POLYMORPHININÆ.**

59. POLYMORPHINA ELEGANTISSIMA,\* Parker & Jones.
60. P. PROBLEMA, d'Orb.; C.R., pl.lxxii. f.20.
61. P. ALVEOLINIFORMIS, n.sp.; see p.822, and Pl.xxiii., figs.1-6.
62. RAMULINA GLOBULIFERA, Brady, pl.lxxvi. f.22-28.
63. RAMULINA sp.

Family **GLOBIGERINIDÆ.**

64. ORBULINA UNIVERSA,\* d'Orb.
65. GLOBIGERINA (wild-growing monstrous bottom forms), cp. C.R., pl.lxxxi. f.6 and 7.
66. G. BULLOIDES,\* d'Orb.
67. G. CONGLOBATA,\* Brady.

Family **ROTALIDÆ.**

Subfamily **ROTALINÆ.**

68. TRUNCATULINA LOBULATA,\* Walker & Jacob.
69. T. HADINGERII,\* d'Orb.
70. PULVINULINA ELEGANS, d'Orb.
71. CARPENTARIA PROTEIFORMIS, Goës; C.R., pl.xcvii. f.8-14.
72. C. BALANIFORMIS, Gray; C.R., pl.xcviii. f.14-17.
73. C. MONTICULARIS (young sp.); C.R., pl.xcviii. f.13, 15, 16.
74. RUPERTIA STABILIS, Wallich; C.R., pl.xcviii. f.1-12.
75. ROTALIA CALCAR, d'Orb; C.R., pl.eviii. f.3.

## Subfamily TINOPORINÆ.

76. TINOPORUS BACULATUS, Carpenter; C.R., pl.ci. f.4-7; very rare.

77. POLYTREMA MINIACEUM, Linné.

*New Species and Notes.*

RHEOPHAX EUNETA,\* n.sp. (Pl.xxiii., figs.5-7a and b).

Only three fair specimens were obtained. The tests being very frail had been demolished through crushing. The test consists of a closely matted network of spicules which, being insoluble in hydrochloric acid, somewhat boomerang-shaped, and containing axial canals, seem to be siliceous spicules of monactinellid sponges (fig.6). The tests of the specimens described were of a light brown colour and were made up of three or four chambers placed in a straight line, the first (or initial) chamber sometimes being the largest (fig.5). The chambers are hollow and connected with one another by wide openings. The total length of the test varies from 3-4 mm., and the width is about 1 mm. The specimen shown in fig.5 measured 4 mm. in length. The closed initial chamber was  $1\frac{3}{4}$  mm. long, the second  $\frac{5}{7}$ , the third  $\frac{5}{7}$ , and the fourth  $1\frac{1}{4}$  mm. The chambers are barrel-shaped. The organism differs from the genus *Technitella* in the reddish colour of the material cementing the spicules of the test, and in possessing more than one chamber. In these points it agrees with the genus *Rheophax*, as well as in building up its test with foreign particles. The close matting of the spicules is, however, as beautiful and perfect as in *Technitella*.

POLYMORPHINA ALVEOLINIFORMIS, n.sp. (Pl.xxiii. figs.8-12.)

Length 3-6 mm.; width about 1 mm. Colour yellowish-white like that of some large *Cristellarias* with which it is associated; aperture polymorphine (multiradiate), in some specimens triangular or circular and not showing the radiating grooves distinctly; generally three chambers show on the surface, sometimes

\*εὖνητος, well spun.

two or four; suture-lines only faintly marked on the shell-surface; surface smooth and shiny; shape of test elongate-ovate. The shell is composed of carbonate of lime and an organic material which is left after treatment with acid. In minute structure, colour and composition the test is like that of *Cristellaria*; but the arrangement of the chambers recalls that of *Miliolina alveoliniformis*, though it is more variable. Longitudinal sections show that the earlier chambers sometimes have parts of their walls resorbed when enclosed in larger ones, so that small apertures open communication between them (see fig. 11). A transverse section (see figs. 12a and 12b) shows a close resemblance to that of *Miliolina agglutinans*.

The shell is made up of fibrous prisms of calcite placed at right angles to the external surface, and is of much greater thickness than is usual in the family, the thickness of shell recalling *Nubecularia*. It seems that where the walls of two chambers adjoin they coalesce, greatly increasing the thickness at that point (see fig. 10).

Fig. 13 shows a specimen allied to *Lingulina carinata*, Hantken. This is the largest foraminifer obtained in the Byron Bay material, the length being equal to that of *Polymorphina alveoliniformis*. It is a much more swollen variety than the typical *L. carinata*, and seems to have affinities with the genus *Gonatosphaera* of Guppy. The final chamber is often broken off, leaving a ridge (r. fig. 13) as in *Gonatosphaera prolata*, Guppy.\*

Of the seventy-seven species identified in the Byron Bay material twenty-four were found by Mr. Whitelegge to be present in Port Jackson, and are enumerated in his List.

### 3. *Foraminifera in beach sand from Lord Howe Island.*

This material was given to me by Mr. C. Hedley, F.L.S., of the Australian Museum. It was very fragmentary; and contained only a few forms, here enumerated.

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\* See Geol. Mag. for June, 1904.

1. TINOPORUS BACULATUS, Carpenter; C.R., pl.ci. f.4-7.
2. ORBITOLITES COMPLANATA, Lamk.; C.R., pl.xvi. f.1-6.
3. HETEROSTEGINA DEPRESSA, d'Orb.; C.R., pl.exii. f.14-18.
4. POLYTREMA MINIACEUM.\*
5. CORNUSPIRA FOLIACEA, Philippi; C.R., pl.xi. f.5-9.
6. CARPENTARIA sp. (fragments).

4. *Coarse Foraminiferal sand dredged off Sydney Heads.*

I am indebted for this material to Messrs. C. Hedley and H. L. Kesteven, of the Australian Museum. It contains numerous species hitherto unrecorded for the vicinity of Sydney.

Family MILIOLIDÆ.

Subfamily MILIOLINÆ.

1. BILOCULINA RINGENS,\* Lamk.
2. B. COMATA,\* Brady.
3. MILIOLINA BUCCULENTA, Brady, C.R., pl.iv. f.1-2.
4. M. INSIGNIS, Brady, C.R., pl.iv. f.8 and 10.
5. M. LINNÆANA, d'Orb.; C.R., pl.vi. f.15-20.
6. M. SEMINULUM,\* Linné.
7. M. SEPARANS, Brady, C.R., pl.vii. f.1-4.
8. M. TRIGONULA, Lamk.; C.R., pl.iii. f.14-16.
9. SPIROLOCULINA EXCAVATA, d'Orb.; C.R., pl.ix. f.5 and 6.

Subfamily HAUERININÆ.

10. HAUERINA ORNATISSIMA, Karrer; C.R., pl.vii. f.15-22.

Subfamily PENEROPLIDINÆ.

11. CORNUSPIRA sp.

Family ASTRORRHIZIDÆ.

Subfamily ASTRORRHIZINÆ.

12. ASTRORHIZA GRANULOSA, Brady, C.R., pl.xx. f.14-23.
13. A. CRASSATINA, Brady, C.R., pl.xx. f.1-9.

Subfamily RHABDAMMININÆ.

14. ASCHEMONELLA sp.
15. JACULELLA sp.



- 16. RHABDAMMINA sp.
- 17. BOTELLINA LABYRINTHICA, Brady, C.R., pl.xxix. f.8-18.
- 18. RHIZAMMINA ALGÆFORMIS, Brady, C.R., pl.xxviii. f.1-11.
- 19. R. INDIVISA, Brady, C.R., pl.xxix. f.5-7.
- 20. R. DISCRETA, Brady, C.R., pl.xxii. f.7-10.
- 21. HYPERAMMINA ARBORESCENS, Normann; C.R., pl.xxviii. f.12-13.

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

- 22. RHEOPHAX NODULOSA,\* Brady.
- 23. R. BACILLARIS, Brady, C.R., pl.xxx. f.23-24.
- 24. R. DIFFLUGIFORMIS, Brady.

Subfamily THURAMMININÆ.

- 25. THURAMMINA PAPILLATA, Brady, C.R., pl.xxxvi. f.7-18.
- 26. AMMODISCUS sp.

Family TEXTULARIDÆ.

Subfamily TEXTULARINÆ.

- 27. TEXTULARIA AGGLUTINANS,\* d'Orb.
- 28. T. GRAMEN, d'Orb.; C.R., pl.xliii. f.9 and 10.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

- 29. LAGENA OVIFORMIS, Terquem; syn. *L. globosa*, Montagu; C.R., pl.lvi. f.1-3.

Subfamily NODOSARINÆ.

- 30. CRISTELLARIA ACULEATA, d'Orb.; C.R., pl.lxxi. f.4 and 5.
- 31. C. GIBBA,\* d'Orb.
- 32. C. ROTULATA,\* Lamk.
- 33. FRONDICULARIA INTERRUPTA, Karrer; C.R., pl.lxvi. f.6 and 7.
- 34. CRISTELLARIA ORBICULARIS, d'Orb.

Family GLOBIGERINIDÆ.

- 35. GLOBIGERINA sp.

## Family ROTALIDÆ.

## Subfamily ROTALINÆ.

35. DISCORBINA ROSACEA, Terquem; C.R., pl.lxxxvii. f.1-4.  
 36. TRUNCATULINA ROSEA, d'Orb.; C.R., pl.xcvi. f.1.  
 37. T. UNGUERIANA, d'Orb.; C.R., pl.xciv. f.9.

## Family NUMMULINIDÆ.

## Subfamily POLYSTOMELLINÆ.

38. POLYSTOMELLA IMPERATRIX,\* Brady.

5. *Foraminifera in beach sands from Lizard Island, Great Barrier Reef, Queensland.*

The material was presented to me, for examination, by Mr. A. E. Finckh, of the Sydney University, and was of the usual type of coral reef sand. On sorting the material by stirring in water and removing the lighter portions, about 1 % of it was found to be of a fine nature, and was specially examined under the microscope.

In the coarse material the following species were abundantly represented.

## Family MILIOLIDÆ.

## Subfamily PENEROPLIDINÆ.

1. ORBITOLITES COMPLANATA, Lamk., var. LACINIATA, Brady, C.R., pl.xvi. f.1-6 and 8-11.

## Family ROTALIDÆ.

## Subfamily ROTALINÆ.

2. CALCARINA SPENGLERI, Linné; C.R., pl.cviii. f.5-7.

## Subfamily TINOPORINÆ.

3. TINOPORUS RACULATUS, Carpenter; C.R., pl.ci. f.4-7.  
 4. GYPSINA GLOBULUS, Reuss; C.R., pl.ci. f.8.  
 5. G. VESICULARIS, Parker & Jones; C.R., pl.ci. f.9-12.

## Family NUMMULINIDÆ.

## Subfamily NUMMULITINÆ.

6. AMPHISTEGINA LESSONII, d'Orb.; C.R., pl.cxi. f.1-7.



The finer portion contained the following species :—

Family MILIOLIDÆ.

Subfamily PENEROPLIDINÆ.

7. CORNUSPIRA FOLIACEA, Philippi; C.R., pl.xi. f.5-9.

Subfamily MILIOLININÆ.

8. TRILOCULINA sp.  
9. SPIROLOCULINA GRATA, Terquem; C.R., pl.ix. f.16 and 17

Family GLOBIGERINIDÆ.

10. GLOBIGERINA sp. (fragmentary).

Family LAGENIDÆ.

Subfamily LAGENINÆ.

11. LAGENA BOTELLIFORMIS, Brady, C.R., pl.lvi. f.6.

Family ROTALIDÆ.

Subfamily ROTALINÆ.

12. PATELLINA CORRUGATA, Williamson; C.R., pl.lxxxvi. f.1-7.  
13. DISCORBINA PARISIENSIS, d'Orb.; C.R., pl.xc. f.5, 6 and 9-12.  
14. D. ROSACEA, d'Orb.; C.R., pl.lxxxvii. f.1-4.  
15. CYMBALOPORA TABELLÆFORMIS, Brady; C.R., pl.cii. f.15-18.  
16. C. POEYI, d'Orb.; C.R., pl.cii. f.13 and 14; plentiful.  
17. ANOMALINA AMMONOIDES, Reuss; C.R., pl.xciv. f.2 and 3.  
18. PLANORBULINA LARVATA, Parker & Jones; C.R., pl.xcii. f.5 and 6.  
19. PULVINULINA AURICULA, Fichtel & Moll; C.R., pl.cvi. f.5.  
20. P. FAVUS, Brady, C.R., pl.civ. f.12-16.  
21. TRUNCATULINA LOBULATA,\* Walker & Jacob.  
22. T. VARIABILIS, d'Orb.; C.R., pl.xciii. f.6 and 7.  
23. ROTALIA VENUSTA, Brady, C.R., pl.cviii. f.2.  
24. R. PAPILLOSA, Brady, C.R., pl.cvi. f.9.  
25. CARPENTARIA PROTEIFORMIS, Goës; C.R., pl.xcvii. f.8-14; both old and young specimens.

## Family NUMMULINIDÆ.

## Subfamily POLYSTOMELLINÆ.

26. POLYSTOMELLA CRISPA, Linné; C.R., pl.ex. f.6-7; plentiful.
27. P. VERRICULATA, Brady, C.R., pl.ex. f.12.
28. NONIONINA BOUEANA, d'Orb.; C.R., pl.cix. f.12 and 13.
29. Other fragmentary Nonionina specimens.

With the exception of the forms recorded as plentiful, most of the above species were only represented by one or two specimens in the sand at my disposal.

6. *Raised Coral Reef Sand from the South of the New Guinea Coast*

Was examined and found to be very similar to the Lizard Island material. It contains chiefly:—

1. ORBITOLITES COMPLANATA, Lamk.
2. TINOPORUS BACULATUS, Carpenter.
3. CALCARINA SPENGLERI, Linné.
4. AMPHISTEGINA LESSONII, d'Orb.

7. *Dredgings made at Palm Island, near Townsville.*

I owe this material to the kindness of Mr. C. Hedley, who made the dredging. It was obtained at a depth of 15 fathoms. So far only the coarser material has been examined.

## Family MILIOLIDÆ.

## Subfamily MILIOLINÆ.

1. BILOCULINA sp.
2. MILIOLINA CULTRATA, Brady, C.R., pl.v. f.1 and 2.
3. M. PARKERI, Brady, C.R., pl.vii. f.14.
4. M. RETICULATA, d'Orb.; C.R., pl.ix. f.2-4.
5. M. VENUSTA, Karrer; C.R., pl.v. f.5 and 7.
6. SPIROLOCULINA LIMBATA,\* d'Orb.

## Subfamily ALVEOLININÆ.

7. ALVEOLINA BOSCH, DeFrance; C.R., pl.xvii. f.7-12.

## Family ROTALIDÆ.

## Subfamily ROTALINÆ.

8. TRUNCATULINA PRÆCINCTA, Karrer; C.R., pl.xcv. f.1-3.
9. T. HUMILIS, Brady, C.R., pl.xciv. f.7.
10. ANOMALINA FOVEOLATA, Brady, C.R., pl.xciv. f.1.

## Family NUMMULINIDÆ.

## Subfamily POLYSTOMELLINÆ.

11. POLYSTOMELLA CRISPA, Linné; C.R., pl.cx. f.6-7.
12. P. CRATICULATA, Fichtel & Moll; C.R., pl.cx. f.16-17.
13. P. MACELLA, Fichtel & Moll; C.R., pl.cx. f.8, 9, 11.
14. P. STRIATOPUNCTATA, Fichtel & Moll; Flint, "Recent Foraminifera," pl.80.
15. P. HEDLEYI, n.sp., Pl.xxvi., fig 14 (see "Notes" *infra*).
16. NONIONINA sp.

## Subfamily NUMMULITINÆ.

17. AMPHISTEGINA LESSONII, d'Orb.
18. OPERCULINA COMPLANATA, DeFrance, var. GRANULOSA, Leymerie, C.R., pl.cxii. f.6, 7, 9, 10.

## POLYSTOMELLA HEDLEYI, n.sp. (Plate xxiii., fig. 14).

Has affinities with *P. crispa* and *P. macella*. It resembles the former in possessing a well-developed callus of supplementary skeleton infilling the umbilicus on either side, and the latter in being very thin and flat, *P. crispa* being rather inflated. It is variable in size, but is usually considerably much larger than *P. macella*. As the figure shows, it differs from both the above-mentioned genera in possessing a set of very minute skeletal bars of a third order which join the secondary. These show as a beautiful striation under the microscope. It often seems to be of a bluish colour. The striation and flatness of the form constitute the main specific characteristics. The average diameter is about 1 mm.

Named after Mr. Hedley, of the Australian Museum.

It is an interesting point that the genera most abundantly represented in this material have beautiful latticed tests, *e.g.*,

*Miliolina reticulata*, *Polystomella hedleyi*, &c. *M. reticulata* is by far the most abundant of the *Miliolidae* present, and the *Polystomellinae* are well represented. One member of this latter genus, *P. craticulata*, Fichtel & Moll, reaches such extraordinary dimensions (over  $\frac{1}{4}$  in. in diam.) that it was found necessary to section it to make sure of its identity. The section showed that the specimen under consideration was in reality *P. craticulata*, answering in every particular with Carpenter's description.\*

The Orbitolites specimens obtained were also of unusual size, approaching  $\frac{3}{4}$  of an inch in diameter, and belong to the smooth variety, thus differing considerably from most of the coral reef forms which belong to var. *laciniata*.

8. *Foraminifera* in a specimen of Eocene limestone, with  
*Turritella*, *Flabellum*, and *Bryozoa*.

Locality uncertain; probably Table Cape, Tasmania, or Muddy Creek, South Australia.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. MILIOLINA TRIGONULA, Lamk.; C.R., pl.iii. f.14-16.
2. M. TRICARINATA,\* d'Orb.
3. M. AUBERIANA, d'Orb.; C.R., pl.v. f.8 and 9.
4. M. CIRCULARIS,\* Bornemann.
5. M. BUCCULENTA, Brady, C.R., pl.cxiv. f.3.
6. M. OBLONGA,\* Montagu.
7. TRILOCULINA CUNEATA, Karrer; biloculine variety; C.R., pl.i. f.19 and 20.
8. SPIROCULINA sp.
9. BILOCULINA RINGENS,\* Lamk.; very plentiful.
10. PLANISPIRINA SIGMOIDEA, Brady, C.R., pl.ii. f.1-3.

Subfamily PENEROPLIDINÆ.

11. CORNUSPIRA INVOLVENS, Reuss; C.R., pl.xi. f.1-3.

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\* Phil. Trans., 1860, pp.538-540, pl.xvii. and xviii.

## Family ASTORRHIZIDÆ.

## Subfamily RHABDAMMININÆ.

12. RHIZAMMINA ALGÆFORMIS, Brady, C.R., pl.xxviii. f.1-11.

## Family TEXTULARIDÆ.

## Subfamily TEXTULARINÆ.

13. TRITAXIA TRICARINATA, Reuss; Chapman, "The Foraminifera," pl.9; and "Verstein. böhm. Kreideform," Pt.1, 1845, p.39, pl.viii. f.60.

## Family CHILOSTOMELLIDÆ.

14. CHILOSTOMELLA OVOIDEA,\* Reuss.

15. ALLOMORPHINA TRIGONULA, Reuss; C.R., pl.lv. f.24-26.

## Family NUMMULINIDÆ.

## Subfamily NUMMULITINÆ.

16. OPERCULINA COMPLANATA, var., LEYMERIE and DEFRANCE.

This list shows that very many forms still living, some of which, marked \*, occurring in Port Jackson to-day, already existed in profusion in Eocene time in more southerly latitudes. Only dust from the specimen, which is kept in the Geological Laboratory at the University, was examined, and the Foraminifera in it were perfect. It is unfortunate that the locality label has been lost.

9. In connection with some work done on the Polyzoa in the Pokolbin Permo-Carboniferous limestone, I sectioned a number of rocks, which proved to be rich in Foraminifera. The following genera were represented in the thin slides:—

1. *Nubecularia* (very abundant).
2. *Nodosaria* (very abundant).
3. *Vaginulina* (?)
4. *Haplophragmium* (rare).
5. *Rotalia* (?)
6. *Spheroidina* or *Globigerina* (?)
7. *Cornuspira* (*involverens*, Reuss ?).

The genera *Nubecularia*, *Nodosaria* and *Cornuspira* have already been identified in Australian Permo-Carboniferous rocks by Mr. W. Howchin, F.G.S. Mr. Howchin describes them in

rocks from the Piper River in north-eastern Tasmania; they are associated here, as at Pokolbin, with *Stenopora*, various Fenestellidæ and other Bryozoa; with marine gastropods and corals.

### Conclusion.

In this investigation it was noticed that the classification of Foraminifera into species is a matter of extreme difficulty, especially in the larger genera. In such the species become scarcely more than large varieties, a fact which bears out the doctrines enunciated by Darwin in "Origin of Species."

More work is needed on the distribution of our Foraminifera both as regards depth and latitude. This kind of work is especially interesting, as it shows how variable and deformed a species becomes on leaving its normal habitat. Littoral species partake of the characters of abyssmal forms on leaving shallow water. Variability is very great in most species of Foraminifera, as one would expect in such a lowly organised group.

The Eocene and Permo-Carboniferous forms enumerated here are only intended to supplement known records by the addition of new localities. Most of these forms have already been recorded by Mr. Howchin.\*

### EXPLANATION OF PLATE XXIII.

- Fig. 1.—*Nodosaria scalaris*, Batsch ( $\times 100$ ).  
 Fig. 2.—*Lagena lævis*, Montagu ( $\times 80$ ).  
 Fig. 3.—*Polymorphina sororia*, Reuss ( $\times 80$ ).  
 Fig. 4.—*Polystomella macella*, Fichtel & Moll. ( $\times 40$ ).  
 Fig. 5.—*Rheophax euneta*, n.sp. ( $\times 16$ ).  
 Fig. 6.— " " single chamber ( $\times 20$ ).  
 Fig. 7a.— " " ( $\times 16$ ).  
 Fig. 7b.— " " ( $\times 16$ ).  
 Fig. 8.—*Polymorphina alveoliniformis*, n.sp. ( $\times 10$ ).  
 Fig. 9.— " " ( $\times 10$ ).  
 Fig. 10.— " " a specimen ground down on one side ( $\times 10$ ).  
 Fig. 11.— " " a specimen partly ground down on one side ( $\times 10$ ).  
 Fig. 12a-b.— " " transverse sections ( $\times 10$ ).  
 Fig. 13.—*Lingulina carinata*, Hantken, var. ( $\times 10$ ).  
 Fig. 14.—*Polystomella hedleyi*, n.sp. ( $\times 40$ ).

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\* Report Aust. Assoc. Adv. Sc. 1893, v. pp. 355, 365.